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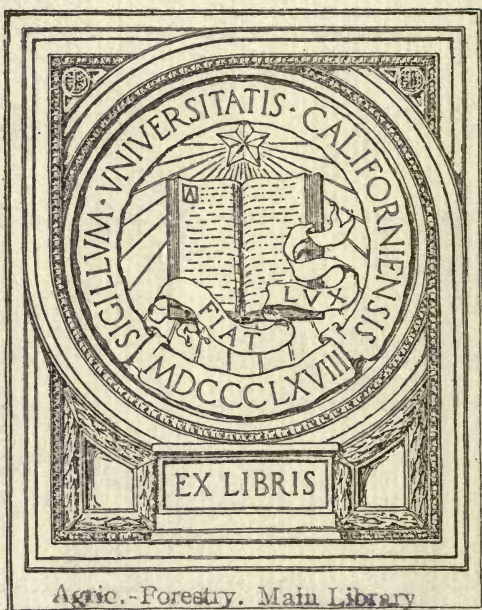
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ARROW-GRASS (*Triglochin maritima*)  
A NEW STOCK-POISONING PLANT

By C.E. Fleming & N.F. Peterson

Univ. of Nevada Bulletin #98 - Jan. 1920

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THE UNIVERSITY OF NEVADA

Bulletin No. 98

January, 1920

# ARROW=GRASS

## A New Stock-Poisoning Plant

(*Triglochin maritima*)

By

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## ACKNOWLEDGMENT

The Nevada Agricultural Experiment Station takes pleasure in thanking A. O. Larson of Castle Dale, Utah, for suggestions which led to the study of the poisonous properties of Arrow-Grass, and to Mr. G. W. Walts of Reno, Nevada, for valuable information and assistance.

## ANNOUNCEMENT

In July, 1918, the Nevada Agricultural Experiment Station published Bulletin No. 95 entitled "Range Plants Poisonous to Sheep and Cattle in Nevada," by C. E. Fleming, head of the Department of Range Management. Hundreds of requests for copies were received from stockmen and forest rangers in Nevada and California. The Foreign Press Bureau of the Committee on Public Information requested 500 copies for distribution in South American countries. Although the number printed was unusually large, the entire edition of this bulletin was soon exhausted and republication has become desirable.

Since the publication of Bulletin No. 95 long series of feeding experiments with poisonous plants have been made at the Nevada Station. Before publishing another general bulletin on the subject of range plants poisonous to sheep and cattle it seems best to print a short series of bulletins giving the results of feeding tests made with each poisonous plant.

We plan later to bring together the results of all the new experiments with all former information on the subject in another illustrated general bulletin on poisonous plants.

S. B. DOTEN,  
*Director.*

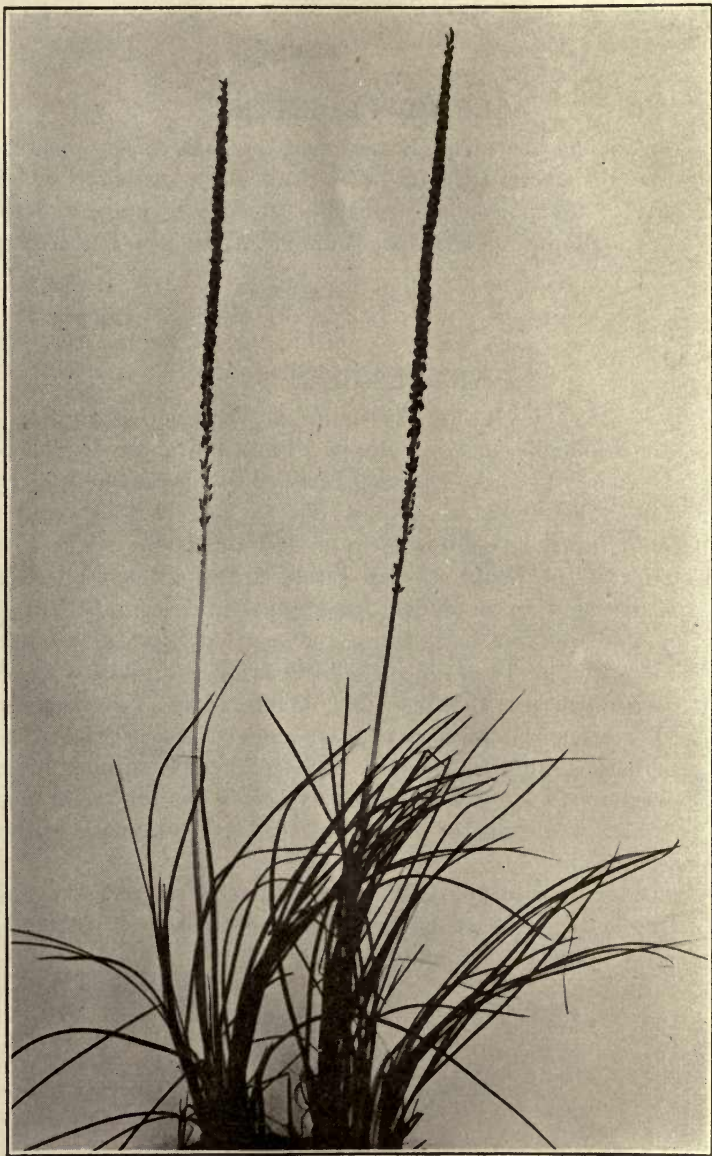


Figure 1. Typical plant of Arrow-Grass, showing cluster of leaves and two flower stalks.



Figure '2. Arrow-Grass, growing among other plants and grasses.

## SUMMARY

1. Recent experiments conducted by the Agricultural Experiment Station of the University of Nevada show that under certain conditions the grasslike plant commonly known as Arrow-Grass is poisonous to both sheep and cattle.

2. Arrow-Grass looks like the common grasses; and often grows among them in wet soils especially where the ground contains alkali.

3. Figures 1, 2 and 3 of this bulletin give a good idea of the general appearance of the plant.

4. Arrow-grass contains an unknown substance, which is sometimes broken up in the stomach of the animal, liberating a deadly poison—hydrocyanic ("prussic") acid gas.

5. Animals fatally poisoned by Arrow-Grass breathe very rapidly at first; they tremble, breathe through the mouth, walk around stiffly, have spasms and go down in convulsions. Later they breathe more slowly and with increasing difficulty, spasms continuing at intervals until death, which occurs in from half an hour to three hours.

6. An animal must eat a large dose at one time in order to be poisoned. Small doses eaten at frequent intervals or moderate quantities eaten daily have no harmful effects.

7. Arrow-Grass cut and dried in hay is far more dangerous and deadly than the green plant.

8. When the body of an animal dead of Arrow-Grass poisoning is cut up there is little indication of the cause of death. There is usually some congestion of the lungs and of the fourth stomach, but neither condition is characteristic of this plant alone.

9. Because of the nature of the poison and because death follows poisoning so promptly, there is little hope of finding methods of treating and curing animals seriously poisoned by Arrow-Grass.

10. Places where Arrow-Grass grows very thickly should be fenced off. Considerable effort should be made to prevent Arrow-Grass from being cut, dried and put up in hay.

# ARROW=GRASS

## A New Stock-Poisoning Plant

(*Triglochin maritima*)

IN THE AUTUMN OF 1918 we were informed by A. O. Larson of Castle Dale, Utah, that cattle had died in southern Utah from eating a plant known in that region as "goose-grass." Fatal poisoning had been caused by the green plants in pastures and more especially by the dried plant in hay. Specimens sent by Mr. Larson to the Nevada Station were identified as "arrow-grass" or "sour-grass" (*Triglochin maritima*). The small amount of material sent from Utah was insufficient to produce any symptoms of poisoning in sheep; however, as this plant is common in wet and semialkaline places in the vicinity of Reno, experimental feedings of larger amounts were begun at once and continued throughout the spring and summer of 1919. These feeding tests showed clearly that under certain conditions the plant is poisonous to both sheep and cattle. The results of these tests are given in detail in this bulletin.

### Common Names.

*Triglochin* is known by three common names — arrow-grass, goose-grass, and sour-grass. Because arrow-grass is the name most commonly and universally used, its adoption and use by stockmen is recommended.

### Description of Plant.

This poisonous plant belongs to a little family of plants known as the arrow-grass family. It grows in bright-green clumps and bunches, so much like grass that it is hard to find in the midst of grasses and other plants until the flower heads and pods have formed. It grows in scattered clumps about 12 inches wide, or in irregular patches which may be from 10 to 20 feet or more across. The flat clumps or bunches of arrow-grass grow from 6 to 12 inches high; and each clump of leaves bears a straight slender flower-stalk, growing to

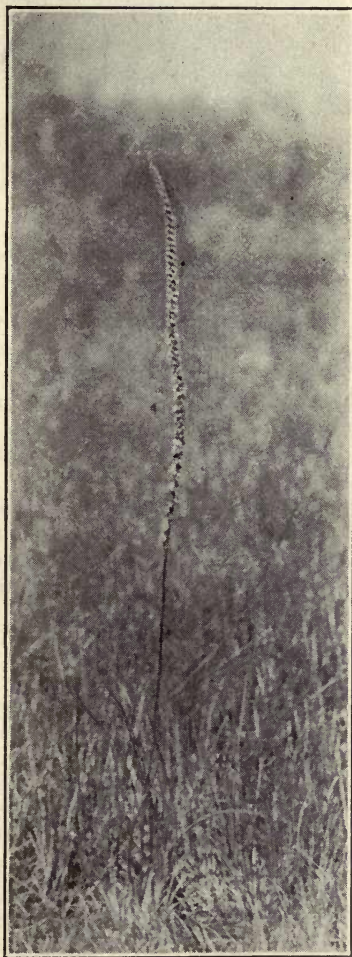


Figure 3. In grass meadows it is hard to find Arrow-Grass before it blooms.

a height of from 12 to 30 inches. The flowers and seed-pods form a slender cluster from 6 to 12 inches long. The flowers themselves are tiny greenish things, and are soon followed by the oblong three-sided seed-pods.

The leaf of arrow-grass is slender, bright-green, very much like grass or sedge. Still it may readily be told from grass by the fact that it is not flat like a grass-blade, but is thick and spongy, flat on one side and round on the other. The leaf of arrow-grass is soft, not wiry and tough like that of a sedge. The leaves are attached to an underground stem, about as thick as a lead-pencil, which pushes its way along beneath the surface, sending up leaves and sending down numerous fibrous roots. The general appearance of the plant is shown in Figures 1, 2 and 3. A flower cluster and a cluster of seed-pods are shown in Figures 5 and 6.



Figure 4. Cross-section of Arrow-Grass leaf, greatly magnified. (X20). The leaf of Arrow-Grass is thick and spongy, not thin and flat like that of ordinary grasses.

#### Distribution.

Arrow-grass is widely distributed over the northern half of the world.

In North America it is found from New Jersey to California and from Labrador to Alaska. On the sea coast it grows in salt marshes; inland it may be found in wet alkaline soils and along the edges of sloughs, associated with grasses and sedges and other plants which require much water.

Three species of arrow-grass occur throughout North America in wet saline or semialkaline soils. At least two of them occur in the pastures and meadows in Nevada, but *Triglochin maritima* being the larger plant and the most common is probably the one responsible for most of the stock losses that occur from eating this plant. It is not definitely known if the other species are sufficiently abundant and poisonous to be dangerous.

#### Losses Due to Arrow-Grass.

But little is known concerning the extent of animal losses caused by arrow-grass. It has not been generally considered poisonous, and many losses attributed to other causes may have been due to this plant. Dried arrow-grass mixed with hay or fed free from mixture is readily eaten. The green plant does not seem to be distasteful to animals, and it is sometimes eaten greedily, although many other poisonous plants, especially those containing alkaloids, are so bitter that stock will eat them only when forced to do so by extreme hunger.

Because of its rather pleasing and acceptable taste and because of the fact that the plant often grows in almost pure patches from a few feet to rods across and produces a large quantity of forage, it would seem easier for animals either on pasture or on hay to get a fatal dose of arrow-grass than of poisonous plants which grow scattered here and there amid other foliage.

#### The Poisonous Principle of Arrow-Grass.

An air-dried sample of the plant (*Triglochin maritima*) used in the feeding experiments was examined in the Station Laboratory and was

found to possess cyanogenetic properties, *i. e.*, would yield hydrocyanic acid ("prussic" acid) upon suitable treatment.

That this might be expected was, in a measure, suggested by the symptoms observed in the feeding experiments. In the literature it appears that Greshoff<sup>1</sup> found from 0.02% to 0.6% of hydrocyanic acid

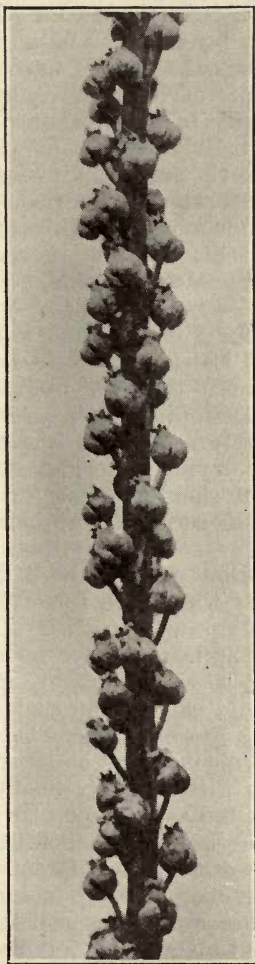


Figure 5. Flowers of Arrow-Grass magnified (X2). Flower is small, greenish, and insignificant.



Figure 6. Seed-pods of Arrow-Grass magnified (X2).

in *Triglochin maritima*. Later Blanksma<sup>2</sup> in working with the same plant found hydrocyanic acid in amounts varying from 0.056% to 0.184%.

<sup>1</sup>Greshoff, M.: A New Natural Group of Plants Containing Hydrocyanic Acid. Pharm. Weekblad, 45. 1165-69, 1907.

<sup>2</sup>Blanksma, J. J.: Hydrocyanic Acid in Sour-Grass (*Triglochin*). Pharm. Weekblad, 50. 1295-1302.

In the plants known as cyanogenetic plants, substances have been found in which hydrocyanic acid is in combination with other compounds. As an example of such compounds may be cited amygdalin, a compound, which will yield hydrocyanic acid and benzaldehyde, found in the bitter almond. Compounds of this sort may be made to give up their hydrocyanic acid by the action of suitable reagents, such as by the action of acids upon amygdalin. Another method of breaking off the hydrocyanic acid is by the action of certain ferments. Almost invariably the cyanogenetic substance is found to be accompanied in the plant by a ferment most suitable for that substance. When the cells of the plant are broken the ferment has opportunity to act upon the hydrocyanic acid-holding compound and the acid is liberated.

The poisonous properties of the cyanogenetic plants may be reasonably thought to be due to hydrocyanic acid liberated as described above. That other poisons are present may be possible and has been suggested, but laboratory examination has failed to disclose the presence of notable amounts of other poisonous substances such as alkaloids or saponins.

In the sample submitted, which had lost 79.2% of moisture in drying, there was found 0.264% hydrocyanic acid. Calculated to the original green weight of the plant, this is equivalent to 0.0549% hydrocyanic acid in the original plant. That there is a possibility that a part of the hydrocyanic acid originally present in the green plant was lost in drying, has been shown to be the case in the drying of sorghums. This would make the above figure lower than it should be for the green plant. Dowell<sup>3</sup> showed that in the drying of sorghum approximately three-fourths of the acid is set free.

Laboratory evidence in this case shows that we have been dealing with a cyanogenetic substance, the nature of which will form the subject of a more technical paper from this Station in the future.

Poisonous plants of this type sometimes appear to have an erratic action both in feeding experiments and also when animals are grazing at will. Apparently the grazing of sheep and cattle upon such plants has not been accompanied with fatal results in every case. The areas from which the samples used in these experiments were obtained have been and are used for the grazing of sheep with the only results that at times lambs succumb. Cattle have been fed safely upon sorghums which unquestionably contained hydrocyanic acid and which at other times and under different conditions of feeding caused fatal results. The leaves of the choke-cherry contain hydrocyanic-producing substances, but poisoning does not necessarily accompany natural feeding, although fatal results have been reported. Linseed cake has been the subject of many experiments,<sup>4</sup> and has been found to contain lethal doses of hydrocyanic acid in the amounts fed, but still was successfully used in feeding and fattening.

In explaining such a state of affairs it is necessary to consider all of the possible factors which contribute to the action of these compounds. Auld<sup>4</sup> has pointed out that under digestive conditions cyanogenesis is likely to be inhibited. He shows that the presence of acids, alkalies, salts, cellulose and glucose all tend to prevent the liberation of the

<sup>3</sup>Dowell, C. T.: Cyanogenesis in *Andropogon Sorghum*. J. Agr. Res. (1919) 16, 17, 175-81.

<sup>4</sup>Auld, S. J. M.: Cyanogenesis under Digestive Conditions. Jour. Agr. Sci. (1913) 5: 408-33.

poison, and that in the cases of feeding in which poisoning occurs it is likely that there is some element which interferes with the inhibition which would normally take place. The possibility of the formation of hydrocyanic acid in the food before feeding is very likely in cases in which the feeding stuff is manipulated or prepared before administration. In the case of green food, only the rupturing of the cells is sufficient to produce the free poison, and in the case of the dry material, which is generally more or less broken up, it is only necessary to introduce moisture to produce the free poison. If inhibition can be due to an alkaline medium, the normal conditions in the mouth during eating and in the rumen of the animal would have a protective action and would tend to prevent poisoning. Anything interfering with normal mastication and the attendant mixing of saliva with the food would evidently interfere with the inhibitory process and end with disastrous results. Auld (*loc. cit.*) points out the protective effect of cellulose and glucose, and that these carbohydrates have an inhibitory action on the evolution of hydrocyanic acid has been observed by other investigators with other plant materials. In fact, it has been recommended<sup>5</sup> that glucose be used as an antidote in cases of poisoning from this source. As a matter of fact, it is probable that the administration of glucose would have but little effect if done after the symptoms of acute poisoning have developed. However, if a suspicious food was to be fed, it might be mixed with a glucose-containing material as a precautionary measure.

Another and equally important factor is that of the physical condition of the animal when fed; the state of its health and whether the food in question is taken upon a partially filled or empty stomach. It would appear in the case of sorghum, for example, that cows turned into sorghum would be fatally poisoned if nothing had been eaten for a short time previously; but if they were first fed and then allowed access to the same plants no poisoning would follow.

#### **The Season of the Year when Arrow-Grass Is Poisonous.**

Feedings were made with arrow-grass cut both in early summer and during fall. It appeared equally poisonous at both seasons. There is good reason for believing that the plant is toxic during the entire period of its growth.

#### **The Part of the Plant which Is Poisonous.**

The greater part of arrow-grass consists of the leaves, the flower stalk making only a small portion of its total weight. The leaves have been conclusively proven to be poisonous. We have not found out whether the flower stalks are poisonous because they are more or less tough and unpalatable and make up only a minor part of the total weight of the plant. The roots are so firmly held down by their fibrous growth that there is little or no chance of their being eaten.

The following tables give the feeding tests which were made with sheep and cattle in the fall of 1918 and the spring and summer of 1919; all the animals were fed the fresh green leaves except a single sheep weighing seventy pounds which was fed three-fourths of a pound of the green fruits without results:

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<sup>5</sup>Peters, A. F., Slade, H. B., and Avery, Samuel: Poisoning of Cattle by Common Sorghum and Kafir Corn. Nebraska Station Bulletin No. 77.

SHEEP-FEEDING TESTS WITH GREEN MATERIAL, 1918-1919

Animal No.	Weight of animal	Date	Time fed	Amount fed	Time symptoms appeared	Time of death or recovery	Final result
42-----	70 lbs.	10-7-1918	4:40 p. m.	$\frac{1}{2}$ lb.	None	-----	-----
40-----	100 lbs.	10-7-1918	4:30 p. m.	1 lb.	None	-----	-----
39-----	97 lbs.	10-8-1918	3:10 p. m.	$4\frac{1}{2}$ lbs.	3:25 p. m.	4:13 p. m.	Death
42-----	75 lbs.	10-10-1918	4 p. m.	2 lbs.	-----	-----	Slightly sick
		10-15-1918	11:40 a. m.	2 lbs.	12:05 p. m.	1:40 p. m.	Death
46-----	72 lbs.	10-29-1918	2:30 p. m.	$\frac{3}{4}$ lbs.	None	-----	-----
	75 lbs.	11-7-1918	9 a. m.	$2\frac{1}{2}$ lbs.	None	-----	-----
26-----	75 lbs.	4-12-1919	9 a. m.	1 lb.	None	-----	-----
29-----	81 lbs.	4-15-1919	9:30 a. m.	1 lb.	None	-----	-----
26-----	75 lbs.	4-15-1919	9:40 a. m.	$1\frac{1}{2}$ lbs.	None	-----	-----
	73 lbs.	6-3-1919	11:40 a. m.	$1\frac{1}{2}$ lbs.	12:50 a. m.	1:15 p. m.	Death
46-----	70 lbs.	6-3-1919	1:15 p. m.	1 lb.	None	-----	-----
		6-4-1919	10:50 a. m.	$1\frac{1}{2}$ lbs.	None	-----	-----
		6-5-1919	10 a. m.	$1\frac{1}{2}$ lbs.	None	-----	-----
		6-6-1919	10 a. m.	2 lbs.	None	-----	-----
		6-7-1919	2 p. m.	$2\frac{1}{2}$ lbs.	None	-----	-----
		6-11-1919	2 to 4 p. m.	$2\frac{1}{2}$ lbs.	4:30 p. m.	7 p. m.	Recovery
		6-12-1919	9:20 a. m.	$2\frac{1}{2}$ lbs.	9:30 a. m.	9:55 a. m.	Death
29-----	80 lbs.	6-11-1919	9 to 10:20 a. m.	$1\frac{1}{2}$ lbs.	10:30 a. m.	10:55 a. m.	Death

As a result of the twenty feeding tests, 7 sheep were poisoned, 5 of which died. The weight of green material required to make a sheep sick or to kill it varied from  $1\frac{1}{2}$  pounds to  $4\frac{1}{2}$  pounds, the average fatal dose being approximately 2.4 pounds. Because of the extremely irregular way in which plants containing hydrocyanic acid act on animals, it would be difficult to state accurately just how much of the plant is required to kill a sheep or to make it sick.

However, the above tests demonstrate conclusively that arrow-grass is a plant containing an active poison, and, although the amounts necessary to produce sickness or death may seem high, in reality they are not; for the plant is made up of a rather open cellular structure containing a high percentage of water. Further, when poisoning does take place death is likely to follow; this is shown by the fact that of 7 animals poisoned 5 died. Four of the deaths were caused by  $2\frac{1}{2}$  pounds or less of green material.

A series of feeding tests with cattle made in spring, summer and autumn with green arrow-grass failed to cause poisoning. The tests are summarized in the table at the top of page 13.

Two pounds of green arrow-grass had no effect on Steer No. 735. In October this animal ate an average of  $15\frac{3}{4}$  pounds daily for 7 days or a total quantity of  $110\frac{1}{4}$  pounds, with no bad effects. The material for this test as shown in the table was collected during October. The June feeding tests also resulted negatively.

These results cannot be taken to mean that fresh green arrow-grass is not poisonous to cattle; for we must constantly keep in mind the irregular and apparently inconsistent action of plants containing hydrocyanic acid. There is a possibility that under different conditions of feeding and at another time the feeding of the same quantity or even less would have caused poisoning. Many valuable forage plants in the sorghum group contain hydrocyanic acid; and yet they are ordinarily fed without causing losses. However, on the other hand, rather serious losses in cattle have been caused by the sorghums. With arrow-grass, the same erratic action may be expected. This test would seem to indicate that pastures where arrow-grass grows are ordinarily not dangerous to cattle; still, there is always a possibility that they may eat just the right amount at the right time with deadly results.

**CATTLE-FEEDING TESTS WITH GREEN LEAVES, 1918-1919**

Animal No.	Weight of animal	Date fed	Time fed	Amount fed
735.....	530 lbs.	10-10-1918	3 p. m.	2 lbs.
	515 lbs.	10-10-1918	4 p. m.	9½ lbs.
		10-12-1918	9 a. m.	11 lbs.
		10-15-1918	9 a. m.	19 lbs.
		10-22-1918	12 p. m.	20 lbs.
		10-23-1918	10 a. m.	14 lbs.
		10-26-1918	2 p. m.	23 lbs.
		10-27-1918	9 a. m.	-----
		10-27-1918	12 m.	10 lbs.
		10-27-1918	4 p. m.	4 lbs.
1.....	137 lbs.	4-15-1919	11:30 a. m.	1½ lbs.
		6-4-1919	10 a. m.	13½ lbs.
		6-5-1919	8:30 p. m.	-----
		6-5-1919	1 p. m.	8½ lbs.
		6-5-1919	8 p. m.	-----
		6-6-1919	8 a. m.	6½ lbs.
		6-7-1919	1 p. m.	-----
		6-7-1919	3 p. m.	2½ lbs.
		6-8-1919	2 p. m.	4 lbs.
		6-10-1919	1 p. m.	8½ lbs.
7.....	141 lbs.	6-10-1919	5:30 p. m.	8½ lbs.
		6-10-1919	10:30 p. m.	-----
		6-11-1919	8:30 a. m.	13½ lbs.
		6-11-1919	5 p. m.	-----

**Feeding Arrow-Grass in Hay.**

The following feeding tests were made with sheep and cattle to determine the effect of various proportions of dry arrow-grass when put up in hay and fed. The plant material for these feedings was collected in 1919 on a ranch near Reno. One lot of 26½ pounds of fresh arrow-grass was collected June 3, 4 and 5 and air-dried to 5½ pounds. Another lot of 38¾ pounds was collected on August 9 on the same ranch and air-dried to 9 pounds.

**SHEEP-FEEDING TESTS WITH AIR-DRIED ARROW-GRASS**

Animal No.	Weight of animal	Date fed	Time fed	Amount fed	Time symptoms appeared	Time of death or recovery	Final result
60.....	94 lbs.	8-5-1919	4 p. m.	8 ozs.	4:50 p. m.	5:50 p. m.	Death
37.....	83 lbs.	8-5-1919	4:20 p. m.	-----	-----	-----	-----
			4:45 p. m.	12 ozs.	5:30 p. m.	Night	Recovery
58.....	101 lbs.	8-6-1919	10 a. m.	-----	-----	-----	-----
			11:30 a. m.	4 ozs.	5:15 p. m.	9:30 p. m.	Recovery
53.....	109 lbs.	8-6-1919	10 a. m.	-----	-----	-----	-----
			11:30 a. m.	4 ozs.	-----	-----	Negative
54.....	115 lbs.	8-6-1919	2:30 p. m.	-----	-----	-----	-----
			3:30 p. m.	5½ ozs.	4 p. m.	4:35 p. m.	Death
58.....	100 lbs.	8-7-1919	1:30 p. m.	-----	-----	-----	-----
			2:30 p. m.	4 ozs.	3:20 p. m.	7 p. m.	Recovery
51.....	96 lbs.	8-15-1919	3:30 p. m.	1 oz.	-----	-----	Negative
53.....	105 lbs.	8-15-1919	3 p. m.	1 oz.	-----	-----	Negative
58.....	100 lbs.	8-16-1919	8:50 a. m.	3 ozs.	-----	-----	Negative
51.....	96 lbs.	8-20-1919	6:50 a. m.	1 oz.	-----	-----	Negative
37.....	87 lbs.	8-20-1919	7 a. m.	2 oz.	-----	-----	Negative
61.....	100 lbs.	8-20-1919	7:20 a. m.	3 ozs.	8:30 a. m.	10:15 a. m.	Death
62.....	82 lbs.	8-20-1919	7:30 a. m.	2½ ozs.	8:03 a. m.	9 a. m.	Death

**TESTS WITH A YEARLING CALF**

1.....	133 lbs.	8-8-1919	9:30 a. m.	7 ozs.	9:50 a. m.	10:20 a. m.	Death
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Thirteen feeding tests were made with the air-dried material fed to sheep, six of which tests either made the animal very sick or else caused death. These tests prove conclusively that small amounts of the dried plant are highly poisonous to sheep. The smallest amount which was fatal to a sheep was 2½ ozs., the average fatal dose being approximately



#### **Feeding of Small Amounts at Stated Intervals Mixed with Hay.**

The object of this series of feedings was to determine whether small amounts of air-dried arrow-grass (the total of which if fed at one time would cause sickness or death) would be harmful when fed a little at a time at various intervals. None of the animals were affected except No. 62, which showed symptoms of poisoning after the fourth 1-oz. dose.

The above feeding tests show that there is little or no cumulative effect of small doses fed at short intervals or over a long period of time. Previous to these tests a sheep had been fed 4 ozs. of air-dried arrow-grass which readily killed the animal. However, when 4 ozs. of similar material was fed in 1-oz. doses to a sheep at hourly intervals only sickness was produced. On August 8 at 9:50 a. m. a sheep was given  $\frac{1}{2}$  oz. and thereafter  $\frac{1}{2}$ -oz. feedings were made at approximately hourly intervals until 6:10 p. m. when 1 oz. was fed. In all between 9:50 a. m. and 6:10 p. m. 5 ozs. had been fed without producing any visible symptoms of poisoning.

On August 21 at 10:30 a. m. a prolonged feeding test was commenced and continued until 5:10 p. m., August 23, during which time 45 separate feedings were made of five 1-oz. feedings and forty  $\frac{1}{2}$ -oz. feedings or a total of 25 ozs. with negative results.

From these feedings it appears that there is no cumulative action of the poisonous principle of arrow-grass when eaten in small amounts of less than 1 oz. at short intervals. It may therefore be safely concluded that an animal may eat many small amounts either in hay or on pasture with little danger. Thus, if small quantities of the dried material are uniformly scattered through the hay, there is not much to worry over, so far as the health of the animals is concerned. On the other hand, if there is any considerable quantity in the hay, fatal results may be expected especially if fine, broken material collects in the bottom of the feed racks. Dry arrow-grass is very brittle, easily broken, and may very readily sift to the bottom along with seeds, chaff, and other material. If this takes place, then there is a possibility of fatal poisoning, even though there is only a small amount of the plant in the hay.

#### **DETAILED DESCRIPTION OF TYPICAL CASES OF ANIMAL POISONING**

##### **Case No. 1—No. 39.**

A sheep weighing 97 pounds was fed  $4\frac{1}{2}$  pounds of green arrow-grass leaves at 3:10 p. m. October 8, 1918. The animal appeared sick at 3:25 p. m. within fifteen minutes after feeding. Muscular spasms commenced at 3:30 p. m.; hindlegs pulled up under body; frequent champing of jaws, breathing hard and audible. At 3:40 the sheep was breathing through the mouth which was held wide open with the tongue hanging out; temperature, 102; respiration, 30. At 3:50 p. m. spasms continued; 3:55 p. m., respiration, 21; at 3:58 p. m., severe spasms commenced and breathing practically stopped; at 4:03 p. m., respiration 12, with long intervals between breaths. Expulsion of breath forcible and plainly audible; at 4:12 p. m. respiration had fallen to 8. Death occurred at 4:13 p. m.

Autopsy showed the jejunum severely congested; spleen dark and mushy; kidneys congested; lungs slightly congested; other organs all appeared normal.

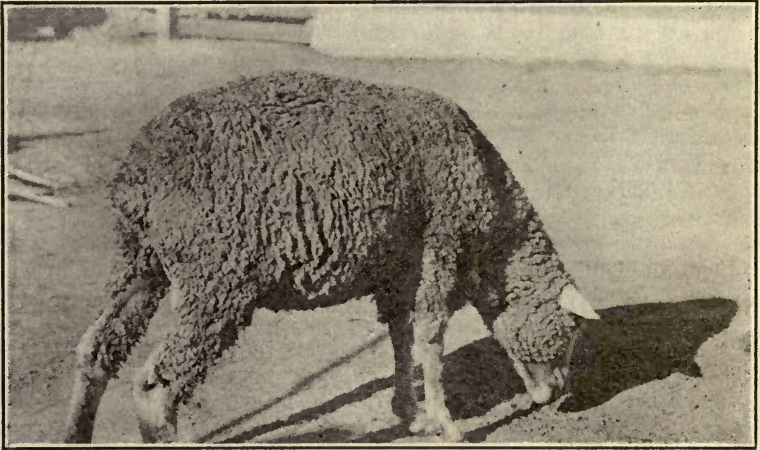
**Case No. 2—No. 42.**

A ewe weighing 75 pounds was fed 2 pounds of green arrow-grass leaves at 11:40 a. m.; at 12:05 p. m. she was walking with a stiff peculiar gait the hindlegs far apart and held back. Soon muscular twitchings commenced. At 12:25 p. m. the respiration was 25. At 12:30 she fell down, displaying spasms with a peculiarly regular up-and-down movement of the head. Spasms occurred at short intervals until a little before death. At 1:28 p. m. the respiration was 19. At 1:37 p. m. the mouth was held open with the tongue out and breathing had almost ceased. Death occurred at 1:40 p. m.

Autopsy showed moderately congested abomasum, spleen dark and mushy, small intestine congested, lungs slightly congested; all other organs apparently normal.

**Case No. 3—No. 26.**

A yearling wether weighing 73 pounds was fed  $1\frac{1}{2}$  pounds of green arrow-grass leaves at 11:40 a. m. At 12:50 p. m. he was down on his



**Figure 7. Sheep in early stages of Arrow-Grass poisoning.**

belly with legs stretched out, mouth open; very audible breathing through mouth, and distinct twitching movements of head and rolling of eyes. At 1 p. m., respiration 16, temperature 103.2. Had a series of spasms at regular short intervals until death, which occurred at 1:15 p. m.

Autopsy showed fourth stomach slightly reddened, small hemorrhages on heart; spleen darkened; all other organs apparently normal.

**Case No. 4—No. 46.**

A ewe weighing 70 pounds was fed  $2\frac{1}{2}$  pounds of green leaves of arrow-grass between 2 p. m. and 4 p. m. She commenced to feel distressed and acted unnatural almost as soon as the feeding was finished, standing with head down, appearing very dull and caring little to move about. This state of inactivity was maintained until 5:45 p. m. when she commenced to brighten up, and at 7 p. m. appeared quite normal, for she was eating a little hay.

Case No. 5—No. 46.

The same sheep as in Case No. 4 was again fed the next day 2½ pounds at 9:20 a. m. and was very sick by 9:30 a. m. She was breathing through the open mouth, with frequent twitching movements of the muscles of the neck, wrinkling movements of the lips and a chewing movement of the jaws. At 9:45 a. m. she was down on her side with spasms most of the time until 9:50 a. m., when she began to regurgitate

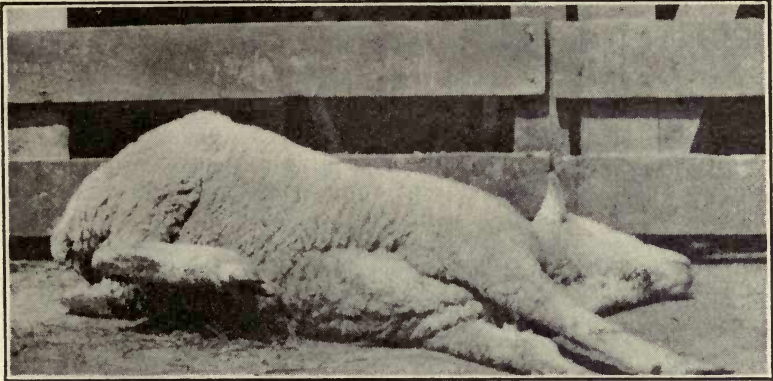


Figure 8. Sheep down in convulsions, Arrow-Grass poisoning.

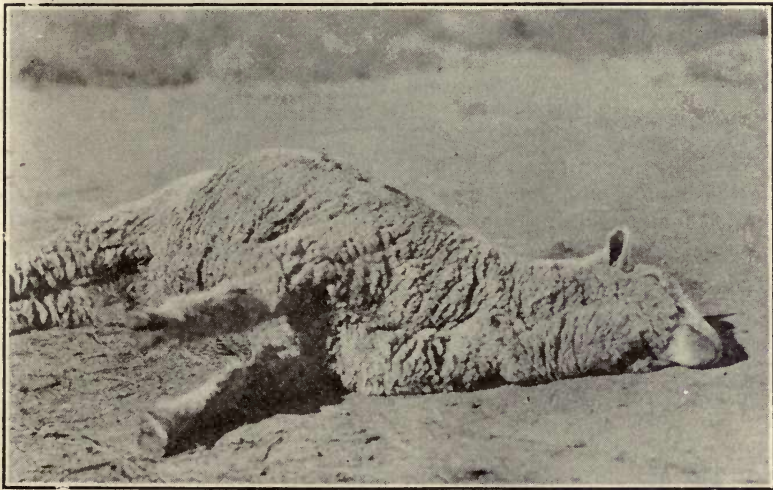


Figure 9. Sheep dying from Arrow-Grass poisoning.

food which passed out both through the mouth and nostrils. Death occurred at 9:55 a. m., thirty-five minutes after she was fed.

Autopsy (by Dr. R. C. Louck) : Slight congestion of fourth stomach, large intestine congested; small hemorrhages on ventricles; all other organs apparently normal.

Case No. 6—No. 29.

A yearling lamb weighing 80 pounds was fed three-fourths of a

pound of green material between 9 a. m. and 10:20 a. m. He was sick at 10:30 a. m. ten minutes afterwards. Breathing through the mouth was very audible; and the animal was soon down on its side. The respiration was 50, temperature 101.4. He lay on his side with difficult breathing and series of spasms at frequent intervals until shortly before death, which occurred at 10:55 a. m., thirty-five minutes after feeding.

The autopsy showed small hemorrhages of the heart; all other organs appeared normal. Because of regurgitation shortly before death, the lungs contained food material.

**Case No. 7—No. 60.**

A ewe weighing 94 pounds was fed 8 oz. of the dry leaves at 4 p. m. At 4:50 p. m. she was down and unable to rise. Peculiar jerky movements of the head took place. At 5 p. m. she began having a series of convulsive spasms at intervals of four or five minutes until death, which occurred at 5:50 p. m. Just before death she vomited a little.

Autopsy showed slight inflammation of colon; severe congestion of both lungs; slight hemorrhages in the endocardium of the ventricles.

**Case No. 8—No. 37.**

A ewe weighing 83 pounds was fed 12 ozs. of the dry leaves between 4:20 p. m. and 4:45 p. m. At 5:30 p. m. she was dull and could hardly be induced to get up. Slight jerky movements of the muscles of the head and neck took place, becoming more pronounced until 7:20 p. m. When next observed, at 9:30 p. m., she was much better, being up and walking about, but still very much indisposed. Next morning at 8 a. m. she appeared to have fully recovered.

**Case No. 9—No. 58.**

A ewe weighing 101 pounds was fed 4 ozs. of the dry leaves between 10 and 11:30 a. m. At 5:15 p. m. she was breathing rapidly, the respiration being 150 per minute. This condition lasted until 7 p. m. No other symptoms were observed. Next morning she was eating a little hay; at 9:30 a. m. the following day she appeared to have fully recovered.

**Case No. 10—No. 54.**

A ewe weighing 115 pounds was fed 5½ ozs. between 2:30 p. m. and 3:30 p. m. At 4 p. m. she was sick, breathing through the mouth; respiration, 104; temperature, 103.6. While standing, frequent jerky muscular movements of the whole body took place. At 4:12 p. m. she was down with head and legs moving almost constantly, except during spasms when the legs were stretched out and the head and neck drawn back. The animal died at 4:35 p. m.

Autopsy showed considerable congestion in rumen and fourth stomach; spleen darkened and mushy; kidneys congested; abdominal lymph glands congested; lungs moderately congested.

**Case No. 11—No. 58.**

A ewe weighing 100 pounds was fed 2 ozs. of the dry leaves at 1:30 p. m. and 2 ozs. more at 2:30 p. m. At 3:20 she was sick; respiration, 70; breathing deep and audible; trembling of the muscles, especially those of the legs. At 3:40 she was down; respiration 30; breathing hard and very audibly through the mouth. She remained down with

head flat on the ground until after 5:10 p. m. At 5:50 p. m. she was up and able to walk, but still quite weak. At 7 p. m. she appeared to have fully recovered.

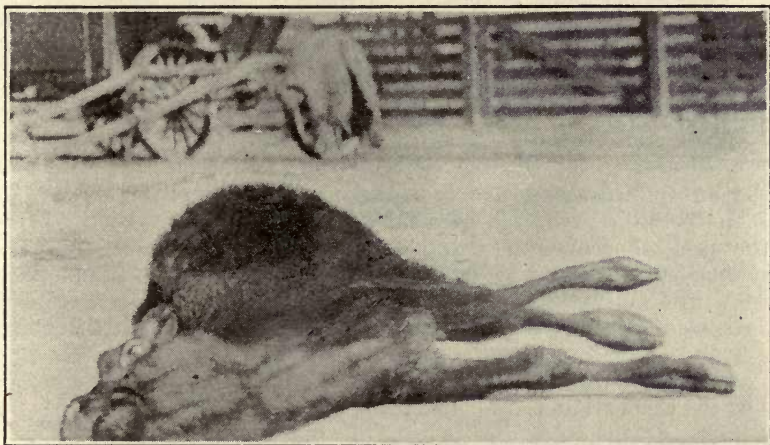
**Case No. 12—No. 61.**

A ewe weighing 100 pounds was fed 3 ozs. of air-dried leaves at 7:20 a. m. At 8:30 a. m. she was sick. Down on side with spasms at 9:30 a. m.; respiration, 44; temperature, 103.6. Breathing was mainly through the mouth. At 10 a. m. she was lying quietly on her side, breathing hard and audibly. Died at 10:15 a. m.

Autopsy showed considerable congestion of lungs and a few small hemorrhages of the heart. Other organs presented no gross lesions.

**Case No. 13—No. 62.**

A ewe weighing 82 pounds was fed 2½ ozs. of dry arrow-grass leaves at 7:30 a. m. Sick at 8:03 a. m., having a peculiar twitching of the muscles. Down on one side at 8:30 a. m. Frequent spasms occurred.



**Figure. 10. Calf dying in convulsions from Arrow-Grass poisoning.**

Respiration, 65; temperature, 104.2. At 8:45 a. m. respiration had fallen to 28. Death took place at 9 a. m.

Autopsy showed congestion of lungs and of the fourth stomach. Other organs appeared normal.

**Case No. 14—No. 62.**

A ewe weighing 82 pounds was fed 4 ozs. of dry leaves, an ounce at a time hourly in order to find out if the poison would be eliminated fast enough so that poisoning symptoms would not develop. The last feeding was at 4:20 p. m. and at 5 p. m. she was sick. The first noticeable symptom was a trembling of the muscles of the legs; respiration, 70. At 5:02 p. m. she was down, breathing through the mouth. She remained in this condition until after 6:30 p. m. At 7:30 p. m. she was up, walking around, but soon fell down again. She was soon on her feet again, but at 7:40 she had another spasm and fell down. At 10:30 p. m. she was up and able to walk around, her gait was very unsteady; the next morning at 7:30 a. m. she appeared to have fully recovered.

**Case No. 15—No. 1.**

A small yearling calf was fed 8 ozs., of which almost 1 oz. was left uneaten at 9:30 a. m. At 9:50 a. m. he was sick. Most of the time he lay on his side and at frequent intervals he had spasms when his head would be pulled back and legs stretched out. At 10:15 the respiration was 10; and he appeared to be dying. He died at 10:20 a. m.

The autopsy revealed no lesions.

**Symptoms of Poisoning.**

The first symptom noted was abnormal breathing, usually very rapid, often as high as 150 per minute, in sheep. In other cases it was slow and deep. As symptoms of poisoning developed, the animal breathed quite freely through the mouth, often with the tongue hanging out. This abnormal breathing was often accompanied by trembling or jerking movements of the muscles. In severe cases these jerking movements would develop into spasms or convulsions. After these started the animal would lie on its side panting through the wide-open mouth. From the time the animal went down until partial recovery or death there would be a series of convulsions at short intervals. Several of the animals vomited just before death, drawing part of the regurgitated material into the lungs, which may have hastened death.

**Autopsy Findings.**

The autopsy findings are few and not characteristic in any way, with the possible exception of congestion of the lungs. Fifty per cent of the cases showed endocardial or epicardial hemorrhages and forty per cent a spleen that was dark and mushy. In general, the blood was darker than normal and formed a clot that was rather soft. The moderate congestion observed in the intestinal tract is of little significance, and, because of the lack of uniformity of the location of the lesion, might be due to other causes. No odor of cyanide was noted in any of the cases; but all the autopsies were made in the open.

If these deaths were due to cyanide poisoning as indicated by the symptoms and chemical findings, the autopsy findings would probably be negligible. Various writers on toxicology consider the post-mortem changes in cyanide poisoning as of little aid in diagnosis. Nunn (*Veterinary Toxicology*, 1907, p. 130) states: "The post-mortem appearances are nothing characteristic, excepting the pervading smell of almonds from the intestines and in a lesser degree from the whole body." Friedberger and Frohner (*Veterinary Pathology*, Vol. I, Translation by Hayes, Sixth Edition 1908, p. 236) say: "Autopsy shows bright-red blood in acute cases, brown when chronic; smell of bitter almonds; signs of asphyxia."

**Feeding Conditions under which Poisoning by Arrow-Grass Is Likely to Occur.**

Few cases of natural poisoning have been observed. In one instance an owner of live stock stated that he had had a number of cows in corral on dry feed for some time. On releasing them they went directly to a patch of arrow-grass which they ate greedily. There was very little grass or sedge in the patch. The poisonous material was therefore but little diluted, and the death of several animals soon followed. The same stockman reported that he was very likely to lose animals when they were fed from a stack of wild-grass hay cut on

meadows containing large quantities of arrow-grass. A sheep owner reported the death of lambs when they fed late in the spring on meadows where arrow-grass was abundant. From the statement it appeared probable that death was due to this plant.

There seems some reason to believe that the plant might cause death in animals which had been on dry feed so long that they would fill up on almost anything green. There appears to be greater danger when the plant is fed dry in hay; the dose required to kill is then far smaller, and there is greater probability that a fatal quantity will be eaten.

#### **Cure of Animals Poisoned with Arrow-Grass.**

No experiments were made to determine whether it would be possible to cure a poisoned animal. Apparently there is little hope or prospect of success, because a dose large enough to cause illness is likely to cause death, and because the interval between the time when the first symptoms appear and the fatal result is too short to permit of treatment.

#### **Prevention of Poisoning.**

With arrow-grass as with other poisonous plants it appears that not much can be hoped for in the cure of animals already poisoned, but that a good deal can be done to prevent poisoning. Wet meadows, where arrow-grass is very common, should not be cut for hay. However, where the plant is distributed in small clumps rather uniformly and is not very abundant there is little danger. The largest clumps should not be cut, or, if cut, should not be loaded on the wagons and should be burned when dry. Animals should not be put on pastures containing an abundance of arrow-grass when they are very hungry. In some cases, moreover, portions of pastures and meadows where arrow-grass grows in great abundance should be fenced and left unused. By these methods it should be easy to prevent losses due to this poisonous plant.

## PUBLICATIONS

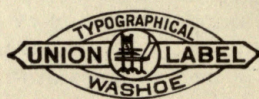
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